

State of Wisconsin/Department of Transportation
RESEARCH PROGRESS REPORT FOR THE QUARTER ENDING: Mar 31, 2002

Program: SPR-0010(36) FFY99		Part: II Research and Development	
Project Title: Effects of Aggregate Coatings and Films on Concrete Performance		Project ID: 0092-00-07	
Administrative Contact: Nina McLawhorn		Sponsor:	
WisDOT Technical Contact: Error! Bookmark not defined.		Approved Starting Date: Oct 1, 1999	
Approved by COR/Steering Committee: \$97,740.00		Approved Ending Date: Feb 28, 2002	
Project Investigator (agency & contact): Steve Cramer: UW-Madison			

Description: Error! Bookmark not defined.

Total study budget	Current FFY budget	Expenditures for current quarter	Total Expenditures to date
\$97,740.00	\$32,580.00	\$0.00	\$0.00

Progress This Quarter:

(Includes project committee mtgs, work plan status, contract status, significant progress, etc.)

This research so far has indicated little or no difference in concrete strength or durability associated with the presence or absence of coatings on coarse aggregate particles. If true, this is a significant finding in that to meet WisDOT specifications coarse aggregate is typically washed to remove small particles and coatings. In addition to the expense of washing, this creates a waste stream of very fine particles that has no other practical use. We theorized that it is not the mere presence of the coating but the mineralogy of the coating which is critical in determining concrete performance. Coatings gathered and tested to date have consisted of primarily dust type particles with trace amounts of clay. A developing theory is that the dust type coatings (small particles derived from the parent rock) up to certain limits are harmless but that the presence of clay particles in even small amounts can be detrimental. We were unable to locate a naturally occurring concrete coarse aggregate that pushed the limits of clay content and would allow us to test our hypothesis. As a last resort, we recently requested and were granted a no-cost extension to allow us to manufacture and evaluate an aggregate with predominantly a clay coating. These efforts went beyond the original study plan.

Early in the quarter, a clayey soil from Sauk County was identified as a potential source for a worst-case aggregate coating. A preliminary methylene blue test resulted in a methylene blue absorption value of 14.21, or approximately double the value measured from the Dodge County aggregate coating. A dirty aggregate was created by attaching fines to the Marathon aggregate. The aggregate had a p200 value of 1.5%. Because the water absorption of the fines was not taken into account (as standard procedure dictates), the concrete mixed with the aggregate resulted in a very low slump of 0.25 in. and a low air content of 3.7%.

A research article, *Absorption Water Content and Liquid Limit of Soils*, suggested that the water absorption of clay fines could be as high as 97%. If the water absorption of the fines is not taken into account, the net water-cement ratio of the concrete could be lowered by as much as 0.04. This might explain why some of the earlier washed mixes performed worse than their unwashed counterparts. Based on the findings presented in the article, liquid limit tests using the cone penetrometer method were used to determine an initial estimate of the absorption of the Sauk County fines. A water absorption of 72% was predicted from a liquid limit of 77%.

A final mixture using the Sauk County fines (p200 = 1.3%) was prepared to correct for the absorption of the fines. Two trial mixtures were used to gauge the effects of additional water on slump and air content readings. For the final 3 ft³ mix, an additional 2.60 lbs of water was added to give a slump of 1.5 in. and an air content of 6.3%. The effective absorption of the fines was approximately 95%, slightly higher than that predicted from the cited research article. At this time, methylene blue testing and cleanness value readings have not been completed for the Sauk County fines. From the first Sauk County concrete mixture, a cleanness value of 16 was recorded. This is significantly below the CalTRANS specification limit of 75 and suggests that the test does not account for the differences between clay and dust coatings.

Strength testing was completed on the first Sauk County mix. However, the values did not seem to differ significantly from the other similar mixes. This is probably due to the low air content of the mix and the lower water-cement ratio from the clayey fines. Some additional work on air dry shrinkage was conducted that will clarify trends between washed and unwashed aggregates.

Hardened concrete air void analyses have been completed for all mixes except the recently manufactured clay coating mixture. Air contents ranged from 5.1% to 8.3%. In general, the air void contents were similar to the fresh air void contents measured with the air meter. The three specimens tested from Mix 2 ranged from 5.3% to 6.3% suggesting that some variability can occur within one freeze-thaw specimen.

Freeze-thaw testing is complete on all mixes part of the original work plan. Testing of the two Turtle Lake fines mixes, the two Sauk County fines mixes, and the Marathon washed remix will begin on April 22.

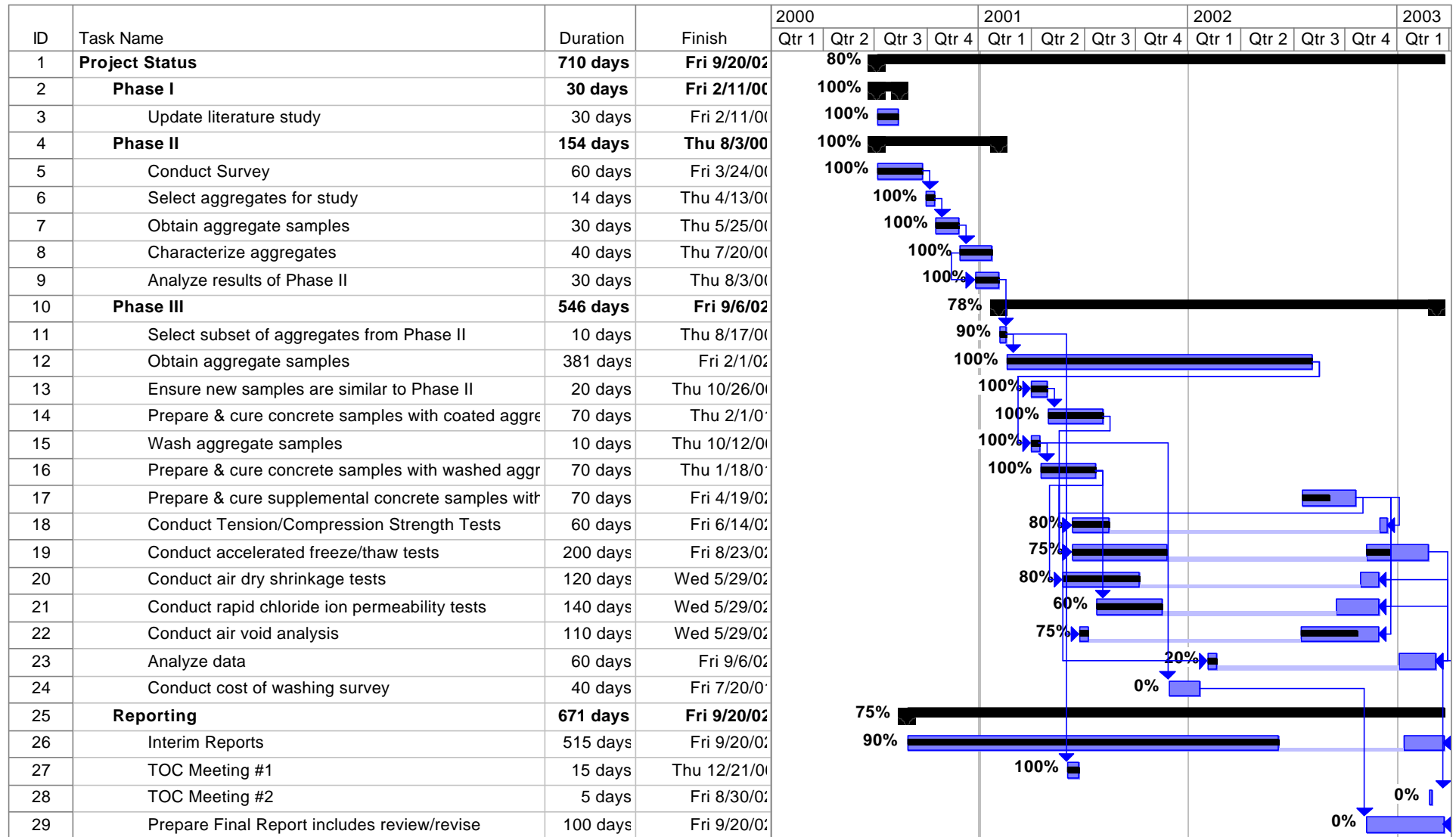
Work Next Quarter:

Work next quarter will primarily consist of freeze-thaw testing of the specimens prepared and data analysis

Circumstances affecting progress/budget:

None

Gantt Chart:



Note: Gantt chart shown in State Fiscal Year Quarters